LORIS S. RUSSELL

Tertiary mammals of Saskatchewan Part I: The Eocene Fauna

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Scope of the Work

The plains and intermontane basins of western North America have provided from their sedimentary rocks the richest and most nearly complete record of Tertiary mammalian faunas that has been found. The northern extension of this great fossiliferous region occurs in the western provinces of Canada, particularly Saskatchewan. The Canadian record is neither as comprehensive nor as richly documented by specimens as is the Tertiary sequence farther south, but it is nevertheless of special interest. Being the northernmost of the known occurrences, the Tertiary fossil deposits of Canada are closest to the Alaskan region, which successive mammalian assemblages must have traversed during periods of faunal intermingling between North America and Asia. Apart from this particular aspect, the Canadian fossils are worthy of study because they reveal variations in morphology and in faunal composition as compared with their analogues to the south.

Since their discovery in the 1880's, the Tertiary mammals of Saskatchewan have been the subject of a number of reports, some of them comprehensive. The last of these appeared in 1940. Since then there have been several collecting expeditions by the Royal Ontario Museum, the Saskatchewan Museum of Natural History, and the National Museum of Canada. The periods covered by these and their principal accomplishments will be given in the appropriate sections of this report. The writer began in 1949 a comprehensive description of the material in the Royal Ontario Museum and issued a preliminary report. Subsequently it was decided to incorporate the results of expeditions by the National Museum of Canada but the work was interrupted in 1956 by administrative duties and has only now been resumed. Meanwhile it has become possible to include a discussion of the rich collection in the Saskatchewan Museum of Natural History.

Originally it was planned that the report on the Tertiary mammals of Saskatchewan would appear as one large monograph. The interruption in its preparation, and the subsequent addition of many specimens to the material still to be described, made it unlikely that the work could be completed in less than three or four years. Also the resultant manuscript would be large and very expensive to publish. It has, therefore, seemed better to issue the results of this study in convenient parts as completed. The present instalment, while serving as an introduction to the series, will consist mainly of descriptions of the Eocene mammals. Subsequent parts will deal with the Oligocene and Miocene faunas. It may be that before the series is completed, the extensive Paleocene rocks of Saskatchewan will have yielded some of the mammalian remains which must be buried within them.

Geographical Distribution of the Tertiary Mammalian Occurrences in Saskatchewan

Tertiary fossil mammals have been found so far only in the southwestern portion of Saskatchewan, mostly in plateau areas that have

preserved the younger sedimentary rocks. The largest of these plateaus is the dissected upland known as the Cypress Hills, which extends with interruptions from range 20, west of the 3rd meridian, in Saskatchewan, to range 3, west of the 4th meridian, in Alberta, a distance of some 60 miles. However, the Oligocene fossil-bearing portion of the Cypress Hills deposits appears to be confined to the extreme eastern part of the hills. To the east and northeast is the Swift Current plateau, on which occur Oligocene deposits similar to those of the Cypress Hills. One islolated occurrence of Eocene deposits is known from the northern end of this upland. South and somewhat east of this, and close to the International Boundary, is the Wood Mountain plateau, which extends eastward from range 6, west of the 3rd meridian. Here fossiliferous gravels of Miocene age are present. Other Miocene occurrences are in the irregular uplands as far east as Big Muddy Valley.

General Geology

The oldest sedimentary rocks exposed throughout southwestern Saskatchewan (except for a small disturbed area in the extreme southwest) are the upper beds of the Bearpaw formation, a rather uniform sequence of marine shales of late Cretaceous (Campanian) age. Near the top are several members of marine sandstone, which thin and disappear to the east. In places both shale and sandstone contain rich beds of marine mollusks. The Bearpaw formation passes above into a transitional series of sandy beds, partly of marine deposition, known as the Eastend formation. This is 100 feet or less in thickness. It in turn is transitional to the Whitemud formation, characterized by an abundance of kaolin, which gives a conspicuous white colour to the majority of the beds. Maximum thickness of the Whitemud formation is about 45 feet. The lower part is sandy but the upper part is usually made up of kaolinized clay, which in many places is of economic value. The Whitemud in turn passes into the Battle formation, formerly regarded as the upper member of the Whitemud. The Battle consists of 40 feet or less of purplish grey clay, with thin tuff beds in places. It has not yielded any fossils as yet. Contact with the overlying Frenchman formation (Lower Ravenscrag of authors) is apparently everywhere an unconformity. The Frenchman has two phases: fine-grained cliff-forming buff sandstone, and grey bentonitic clay. Fossil vertebrates occur, especially in the grey phase, and indicate that the Frenchman beds are the northern equivalent of the Lance formation of Wyoming and the Hell Creek formation of Montana, and correspond to the upper part of the Edmonton formation of Alberta. The age is latest Cretaceous.

The oldest Tertiary formation is the Ravenscrag (in the restricted sense). The contact with the Frenchman is apparently conformable and is usually marked by a noticeable lignite seam. No dinosaur remains have been found above this seam, but mollusks and plants similar to those of the Fort Union group are common. The remains of turtles, *Champsosaurus*, and crocodiles are present but fossil mammals have not yet been

found. The predominant sediments are grey and buff silts, more or less clayey, with thin kaolinized zones in places and numerous lignite seams. The age is believed to be Paleocene.

The younger Tertiary deposits, whose faunas are the subject of this series of reports, rest unconformably upon upper Ravenscrag or older strata. The detailed description of these Tertiary formations is given in their respective parts of the series.

Geological history as recorded by the sequence described above begins with a widespread muddy interior sea in Late Cretaceous time. Sandy deltas formed on the west and extended thin sheets of deposits eastward into the sea. Finally, the sandy deposition became predominant, the marine waters disappeared, and arkosic sands and clays were widely deposited in the low swampy plain, probably from reworking of volcanic deposits farther west. A period of non-deposition with weathering and local erosion followed, at which time the feldspars of the arkoses were converted to kaolin. The erosion surface, of moderate relief, then became the scene of renewed deposition in streams and lakes. The effect was to fill up the low areas first, during the closing of the Cretaceous period. Subsequently the non-marine deposition became general, with extensive swamps in which vegetal matter accumulated. During Paleocene or Early Eocene time this deposition ceased, and some uplift and erosion followed before the close of the Eocene epoch. In Late Eocene time gravels began to spread eastward, carried by powerful streams from the newly uplifted Rocky Mountains, and by Early Oligocene time such deposition was widespread. Later, in Miocene time, these gravels were eroded and transported, to be redeposited farther east. Erosion continued in Pliocene time, but was intensified by Pleistocene glaciation, during which the Tertiary deposits were reduced to the remnants that we see today.

The most comprehensive account of the geology of southern Saskatchewan is Memoir 176 of the Geological Survey of Canada, mainly the work of F. H. McLearn and P. S. Warren, but listed in the bibliography as Fraser *et al.* (1935). More recent but restricted reports are those of Furnival (1946) and Russell (1949).

Acknowledgements

The field work that produced the collections upon which this series of reports is based was supported by various institutions. The expeditions of 1948 and 1949 by the Royal Ontario Museum were made possible by grants from the Research Fund of the University of Toronto. The National Museum of Canada sponsored expeditions in 1951, 1952, 1955 and 1956. The Saskatchewan Museum of Natural History supported field work in 1950, 1951, 1962 and 1963. An expedition in 1964 was sent out by the Royal Ontario Museum.

Individuals who contributed to the success of these expeditions were Mr. L. Sternberg and Mr. R. R. Hornell of the Royal Ontario Museum, Dr. Wann Langston, Jr., the late Mr. G. E. Lindblad, Mr. H. L. Shearman

and Mr. Michael Herniak for the National Museum of Canada, and Messrs. Bruce McCorquodale, Albert Swanston and Fred Lahrman of the Saskatchewan Museum of Natural History.

The thanks of the writer are due to Dr. A. W. F. Banfield, Director of the Natural History Branch, National Museum of Canada, for making available the specimens in that Museum, and to Mr. Fred G. Bard, Director of the Saskatchewan Museum of Natural History for similar privileges with regard to the specimens under his authority. During many years in which the field parties operated in the Cypress Hills, Mr. R. T. Stewart, now of Maple Creek, operated the ranch nearest to the fossil localities and leased the land on which they are located. The thanks of all of those who participated in this work are due to him for providing camp sites, the loan of equipment, and the courtesy of ready access. Mr. H. S. Jones, the well-known fossil collector of Eastend, Saskatchewan, permitted specimens in his collection to be examined and borrowed. Mr. Larry Yost of Rock Glen provided camping privileges and other assistance to the expeditions of 1956 and 1957.

Without access to the important collections of Eocene, Oligocene and Miocene mammals in other museums, these reports would be very difficult to prepare. The privilege of examining and photographing pertinent material was freely extended by the American Museum of Natural History in New York and the Carnegie Museum of Pittsburgh. Dr. H. E. Wood, II, examined some of the rhinoceros material and contributed sections for the Oligocene part.

DESCRIPTION OF THE EOCENE FAUNA

Locality

All of the Eocene mammalian fossils so far found in Saskatchewan have come from one locality, which has been designated, along with the beds exposed, Swift Current Creek. This locality is in legal subdivision 15, section 5, township 15, range 12, west of the 3rd meridian. It is a low cliff on the west side of a valley containing a tributary of Rushlake Creek. The site can be reached by driving 3 miles south and 8 miles east from the city of Swift Current. There is a farm on the west side of the valley just south of the fossil locality. Permission could be obtained to drive through the farm yard along the prairie to a point immediately above the outcrop. Other exposures of conglomeratic sandstone occur in the valley to the north and south, but none has yielded recognizable fossils.

Geology

The Swift Current Creek rocks and their sequence have been described by Russell and Wickenden (1933), and the present account is only a summary. At the type locality the uppermost portion consists of about 10 feet of conglomeratic sandstone, with fossil teeth and bones. Below this are about 30 feet of fine-grained sandstone, not fully exposed, resting in

turn on coarse conglomerate. A few miles to the north a similar conglomerate may be seen to rest unconformably on Cretaceous rocks.

The relationships of the Swift Current Creek beds to the Cypress Hills formation have not been established. Some miles to the southwest, in the valley of Pelletier Lake, there is a thick sequence of sandstones and conglomeratic sandstones similar to those of the Swift Current Creek beds, beneath conglomerates containing a Lower Oligocene mammalian fauna.

History

Mammal teeth were collected from the Swift Current Creek locality by R. T. D. Wickenden of the Geological Survey of Canada in 1930 and 1931. Additional specimens were obtained by Wickenden and Russell in 1932, and the combined collection was the basis for the announcement of the discovery of Upper Eocene deposits in Saskatchewan (Russell and Wickenden, 1933). Unfortunately, the name chosen, Swift Current beds, was already in use for an Ordovician formation in Ontario. So the name for the Saskatchewan Eocene was amended to Swift Current Creek (Russell, 1950). Specimens for the Royal Ontario Museum were obtained here by Russell in 1939 and by L. Sternberg in 1949. In 1956 Russell and W. Langston, Jr., visited the locality for the National Museum of Canada. Dr. H. E. Wood, II, made a small collection here.

Systematic Description

To avoid lengthy repetitions, the institution to which each mentioned specimen belongs is designated by an abbreviation, as follows: NMC, National Museum of Canada, Natural History Branch; ROM, Royal Ontario Museum (in earlier reports the Royal Ontario Museum of Palaeontology); SM, Saskatchewan Museum of Natural History.

Order INSECTIVORA

Family LEPTICTIDAE

Protictops? *borealis*, new species. Plate I, figure 1.

Type. ROM 1676, a right P^4 or possibly M^1; L. Sternberg, 1949.

Specific characters. Size rather large for a leptictid. P^4 ($?M^1$) almost as long as broad; hypocone forming a broadly triangular shelf; metacone angle projecting strongly posteriorly.

Description. The supposed P^4 is relatively broad anteroposteriorly, and the prominent metacone and hypocone areas give the outline a trapezoidal form. The oblique outer margin is nearly straight, with only a small reentrant. Paracone and metacone are bluntly pointed, conical, and subequal, connected by a straight and moderately developed ectoloph. The forward-projecting parastyle is prominent, whereas the posteriorly directed metastyle is less so. The protocone is as high as, but more robust than, the outer

cusps; it has well developed crests diverging towards the parastyle and metastyle, and more or less connected with the external cingulum. There are intermediate cuspules on these crests, the protoconule being the more distinct of the two. The area between the crests is well excavated. The hypocone forms a triangular shelf projecting backward and somewhat inward, and does not reach the level of the metaloph. The anterior shelf, which almost rivals the hypocone in some leptictids, is here relatively small and curved, without any suggestion of a stylar cusp. The internal slope of the protocone is well rounded. Dimensions: anteroposterior, 4.4 mm.; transverse, 4.8 mm.

A lower right molar, M_1 or M_2, ROM 1685 (plate I, figure 2), is provisionally associated with the above-described type. This lower molar has the usual compressed trigonid, with the protoconid prominent although worn, the metaconid about the same size but less worn, and wedged between them a low, rounded paraconid. There is a short remnant of the anterior cingulum. The talonid is long and well basined. The hypoconid and entoconid are subequal and the hypoconulid only slightly smaller. These three cusps are evenly spaced and the hypoconulid projects back very little. The diagonal crest from hypoconid to posterior face of trigonid is not very prominent. Dimensions: anteroposterior, 4.0 mm.; transverse, 3.0 mm.

Remarks. The reference of this species to *Protictops* is an expedient, as it seems probable that an undescribed genus of leptictid is represented. *Protictops* is based on the species *P. alticuspidens* Peterson (1934), known from a lower jaw fragment in the Duchesne River fauna. The lower molar described above differs both in size and structure from the teeth of Peterson's type specimen. Compared with *Ictops dakotensis* Leidy, the common Oligocene leptictid, the upper tooth here described differs from the P^4 of that species in larger size, greater relative anteroposterior dimension, and more prominent hypocone shelf. The lower tooth, compared with the M_1 and M_2 of *Ictops dakotensis*, is a little larger, has a better developed paraconid, and has the crest of the hypoconid rising from a concave, rather than convex, curve. A Middle Eocene leptictid is *Hypictops syntaphus* Gazin (1949) from the Bridger formation. In this species the P^4 and upper molars, although of about the same absolute size as the type of *P.? borealis*, are much narrower anteroposteriorly, and have the hypocone only moderately developed.

Order LAGOMORPHA

Family LEPORIDAE

Mytonolagus petersoni Burke (1934). Plate I, figure 3; plate VI, figure 1.

Referred specimens. NMC 8653, left M^1, Russell and Wickenden, 1932; ROM 1679, left mandibular fragment with P_3 to M_2, L. Sternberg, 1949.

Description. The upper molar has been described previously (Russell and Wickenden, 1933, p. 60). A photographic illustration is offered here to supplement the original figure. In the more recently discovered lower

jaw fragment, all of the teeth are well worn. P_3 is roughly trefoil in outline, with anterior posterior pillars, and a smaller pillar wedged in externally. P_4 is completely molariform. The trigonid is compressed fore-and-aft, and is narrowly ovoid in outline. There is no remnant of the paraconid. Wear has produced a surface that is concave from side to side, the inner (metaconid) end being the higher. The talonid is nearly circular in outline, with a slight angulation at the outmost point. It is worn into a simple shallow basin, without remnants of marginal cusps. M_1 is slightly longer than P_4 and has a wider trigonid, the outline of which is slightly diamond-shaped, rather than simply ovoid. Here again the metaconid side remains the higher. The talonid, as in P_4, is sub-circular with an outer angulation, but is more flattened posteriorly. M_2 resembles M_1 very closely, but is inclined more forward. A remnant of the alveolus for M_3 is present. Dimensions: P_3, anteroposterior, 1.5 mm.; transverse (at triturating surface), 1.7 mm.; P_4, anteroposterior, 2.2 mm.; transverse, 2.3 mm.; M_1, anteroposterior, 2.3 mm.; transverse, 2.6 mm.; M_2, anteroposterior, 2.1 mm.; transverse, 2.3 mm.

Remarks. There can be little doubt that the M^1 pertains to this species. Its structure is almost identical with the M^1 of Burke's paratypes (Nos. 11932 and 11935), although a little smaller in dimensions. A. E. Wood (1949) has added a second species, *M. wyomingensis*, from the Duchesne River equivalent of Wyoming, characterized in part by a reduction of the enamel on the external side of the upper teeth. On this criterion the Saskatchewan tooth is closer to *M. petersoni*. The more recently discovered lower teeth agree well in size with corresponding teeth of *M. petersoni*, and are closely comparable with Burke's paratype No. 11935.

At the time that the Swift Current Creek fauna was originally described, the description of *Mytonolagus* was still unpublished. I was not prepared to erect a new genus on the basis of a single tooth, and therefore referred the M^1 to *Palaeolagus*? sp. It should be understood that this was merely a nomenclatural device.

Order RODENTIA

Family PARAMYIDAE

Paramys sp. Plate I, figure 4.

Referred specimen. ROM 1677, a lower right molar, probably M_2, collected by L. Sternberg, 1949.

Description. In outline the crown is trapezoidal, the anterointernal angle being in advance of the anteroexternal. The former is the point of the metaconid, the most prominent cusp of the tooth. The protoconid area is well worn and slightly chipped. The basin of the talonid is broad and shallow. The hypoconid is directed posterointernally. From the hypoconid two crests extend inward. The more anterior of these crests is narrow and delicate and runs in a slight arc from near the tip of the notch to the entoconid; the more posterior crest curves backward as well as inward and merges with the posterior wall, following it to the entoconid. There is a

slight notch between the entoconid and the marginal ridge from the metaconid. Dimensions: anteroposterior, 3.2 mm.; transverse, 2.9 mm.

Remarks. Individual teeth of *Paramys* are difficult to identify as to species. There was not much change in pattern throughout the Eocene, and even if there were, most of the type specimens have the lower molars too much worn to show the finer details. The present specimen is smaller than the corresponding tooth in most Middle and Upper Eocene species. *Paramys (Reithroparamys) delicatissimus* Leidy of the Bridger and *P. sciuroides* (Scott and Osborn) (1890, p. 475) of the Uinta have approximately the same dimensions in the lower molars.

The right P_4 (NMC 8652; plate I, figure 5) referred by the writer (Russell and Wickenden, 1933, p. 60) to *Paramys* sp. was subsequently examined by Dr. A. E. Wood, who gave the opinion (personal communication) that the presence of a well defined cingulum on outer and inner sides indicates that some genus other than *Paramys* is represented. In view of this opinion, the specimen is referred provisionally to *Paramys*? sp.

Mytonomys robustus (Peterson, 1919)? Plate I, figure 6.

Referred specimen. ROM 1678, an upper right molar, presumably M^2, collected by L. S. Russell, 1939.

Description. This is a relatively large, robust tooth, with the cusp pattern well worn. The outline of the crown is nearly circular, with the inner wall sloping, rather than vertical. The protocone area is worn to a broad, shallow basin, from which four lophs run outwards. The anteroloph is not worn through except at its junction with the protocone area; it is low, and ends at the anteroexternal angle without a distinct parastyle. The protoloph runs directly outwards to the paracone, which is a prominent marginal cusp. This loph is worn through for most of its length. The valley between protoloph and metaloph is broad, but becomes narrow and notched towards the protocone, and almost completely closed externally by the ectoloph. There is no distinct mesostyle. The metaloph runs obliquely backwards as well as outwards, terminating in a marginal metacone; it is worn through for most of its length, and there is an expanded portion just outside of the protocone area which suggests a metaconule. The posteroloph runs into the posterior margin; it is well worn but not worn through except at its junction with the protocone area; it becomes indistinct towards the external margin and there is no metastyle. Dimensions: anteroposterior, 8.0 mm.; transverse, at worn surface of the crown, 8.1 mm.; transverse at greatest width of crown, 10.1 mm.

Remarks. Peterson (1919, p. 65) described two incomplete lower jaws from the Myton member of the Uinta formation as *Prosciurus*? *robustus*. Because the size of these specimens is much greater than that seen in other species of *Prosciurus*, it has been suspected that another genus was represented. A. E. Wood (1956) proposed the new genus *Mytonomys* for "*Prosciurus*" *robustus*, and later (1962) included "*Leptotomus*" *burkei* Wilson from the Upper Eocene part of the Sespe formation of California. With the exception of an upper molar and incisor tentatively referred to the latter species, the genus is known only from the lower dentition.

The reference of the upper molar, ROM 1678, to *Mytonomys* is inferential. The specimen closely resembles the corresponding teeth of species of *Prosciurus* from the lower Oligocene. Apart from the marked difference in size, the only notable distinction is the absence of parastyle and metastyle on the Swift Current tooth. Similarly, the lower teeth of *Mytonomys* differ from those of *Prosciurus* mainly in their much greater size. The probability that ROM 1678 is from the upper dentition of a species of *Mytonomys* seems very great.

As to the species represented by the Saskatchewan tooth, it seems to be distinct from that represented by the upper molar provisionally referred to *Mytonomys burkei*, for the latter is described as having a distinct hypocone and a strong buccal cingulum or elongate mesostyle. Of course the reference of the California tooth may be incorrect, but because of it, and because of the general resemblance of the Swift Current Creek fauna to that of the Myton pocket, ROM 1678 is provisionally referred to *Mytonomys robustus*.

Order CARNIVORA

Family MESONYCHIDAE

Genus and species undetermined. Plate VII, figure 1.

Referred specimen. NMC 8651, right P^4, collected by R. T. D. Wickenden, 1931.

Remarks. Little can be added to the comments originally made on this specimen (Russell and Wickenden, 1933, p. 59). However, the stereoscopic photographs here reproduced give a better representation of the tooth than does the earlier drawing.

Order CONDYLARTHRA

Family HYOPSODONTIDAE

Hyopsodus fastigatus Russell (1933). Plate II, figures 1–5; plate III, figure 1.

Original description. Royal Soc. Canada, Trans., ser. 3, vol. 37, sec. 4, p. 61, pl. 1, fig. 4, 1933.

Type. NMC 8654, left M_2; paratypes, NMC 8655, 8656, 8657, lower molars; collected by Wickenden and Russell, 1932.

Referred specimens. ROM 1682, 1683, 1684, lower molars; ROM 1681, right M^1; collected by L. Sternberg, 1949.

Description. The lower molars in the Royal Ontario Museum agree in most details with the type material. This is particularly true of the size, the elevated cusps, and the well-developed entoconid. The presence of a small but distinct metastylid is characteristic of the type specimens. In ROM 1683 this cuspule is equally developed, but in ROM 1682 it is smaller than in the type material, and in ROM 1684, a right M_3, it is absent. This last-mentioned specimen displays the large heel characteristic of the third lower

molar. The talonid basin is wide. The hypoconid is crescentic but only slightly worn. The hypoconulid, in contrast to that of the more anterior molars, is large and posteriorly projecting. The entoconid is in the form of a ridge, which runs forward from the hypoconulid along the inner margin and is incompletely divided into two portions by a slight notch. This ridge joins with a ridge from the posteroventral slope of the metaconid to form a low wall on the inner side of the talonid basin. Dimensions: ROM 1682, right M_1, anteroposterior, 5.4 mm., transverse, 3.7 mm.; ROM 1683, left M_1 or P_4, anteroposterior, 5.1 mm., transverse, 4.5 mm.; ROM 1684, right M_3, anteroposterior, 4.7 mm., transverse, 3.2 mm.

As an upper molar that might represent *H. fastigatus* has not been described before, the structure of ROM 1681 is considered in detail here. The outline of the crown is broadly rectangular, for which reason the tooth is identified as M^1. The cingulum is poorly developed except on the anterior face. The paracone and metacone are subequal, the former a little higher and more slender; the crest connecting these two cusps is straight. There is no parastyle and only a rudimentary metastyle. The protocone is large and conical, connected by a protoloph with a moderately large protoconule. The loph continues only a little past this conule, terminating in a sort of bulge on the anterior margin, internal to the paracone. Below the protoloph is a bulging cingular shelf, with the side of the crown indented above it. The metaconule is low and rounded-conoid, isolated from the other cusps and situated about equidistant from protocone, metacone and hypocone. The hypocone resembles the protocone and is almost as large. It is separated from the protocone by an angular valley, and it sends a curving crest along the posterior margin of the crown to the metastyle. The surface of the crown between the protoconule and metaconule is angularly basined. Dimensions: anteroposterior, 4.6 mm.; transverse, 5.6 mm.

Remarks. The additional lower molars, in the ROM collection, seem to call for no special comment except that on the basis of these teeth the species seems rather distinct. The single upper molar, by comparison with species in which both upper and lower dentitions are known, is of about the right size to represent *H. fastigatus*. If it actually does, then it becomes difficult to separate this species from *H. uintensis* Osborn (1902). This latter species, based on upper cheek teeth, has an M^1 that is very similar in size to ROM 1681, and differs only in the slightly greater prolongation externally of the protoloph. The discovery of the lower dentition of *H. uintensis* would settle this matter, but in any case, the two species must be closely related.

Order PERISSODACTYLA

Family EQUIDAE

Epihippus sp. Plate III, figure 2.

Referred specimen. ROM 1688, an unworn left M_3, collected by L. Sternberg, 1949.

Description. In outline the crown is elongate-ovoid, tapering posteriorly.

The cusps are unworn, suggesting that the tooth was not fully erupted. The trigonid is widely and obliquely triangular, but the paraconid is absent, the protolophid curving back towards the metaconid without any cusp termination. The protoconid is large, with a crescentic crest formed by protolophid and metalophid; the external side slopes steeply, but the corrugated internal slope is gentle into the trigonid basin, which is open on the internal side of the tooth. The metaconid is high, and together with the closely adjoined metastylid, forms a prominent cone. The metolophid terminates at the metaconid, but the hypolophid does not reach the metastylid. The talonid basin is broader and more angulate in outline than the trigonid basin, and is narrowly and deeply open internally. The hypoconid resembles the protoconid but its crests are less curved. The entoconid is high and conoid, like the combined metaconid-metastylid, but with a single apex. As is characteristic of the M_3, the hypoconulid forms a posterior spur, which is directed backwards and a little outwards. The margin of this spur is a continuous crest, curving around from its juncture with the posterior hypoconid crest to the posterior side of the entoconid. There is a distinct cusp on the posteroexternal side of this crest, corresponding to the apex of the hypoconulid. The spur is deeply basined, like an inverted cone. Dimensions: anteroposterior, 11.8 mm.; transverse, 6.3 mm.

Remarks. The form of the cusps, and particularly that of the hypoconulid spur, suggests the Oligocene genus *Mesohippus*, so it seems that a progressive species is represented. For this reason the reference to *Epihippus* is probably correct. In size the tooth corresponds to the lower molars of *Epihippus gracilis* Marsh (Granger, 1908, p. 258), and it may well represent that species.

Epihippus? sp. Plate III, figures 3–5.

Referred specimens. NMC 8661, incomplete left upper molar, Russell and Wickenden, 1932; ROM 1687, right P^4, Russell, 1939; ROM 1686, left upper tooth, probably DM^4, L. Sternberg, 1949.

Description. The fragmentary upper molar in the NMC collection has been described previously (Russell and Wickenden, 1933, p. 63). ROM 1687 is almost unworn; it has a broadly rectangular crown, somewhat rounded on the inner side. The paracone and metacone are high, sharp and conical, connected by a straight crest, without distinct mesostyle. The parastyle projects forward prominently, whereas the metastyle is rudimentary. The outer wall of the crown is excavated between paracone and metacone, and to a lesser degree in front of paracone and behind metacone. The protocone is high and conical, but more massive than the outer cusps. From it the protoloph descends steeply, then rises to the conical protoconule and continues to the vicinity of the parastyle. The hypocone is almost as high as the protocone, and is separated by a deep, angulate valley. The hypoloph resembles the protoloph, but the metaconule is hook-shaped, curving back, and separated from the metacone by a notch. There is a marginal crest or cingulum from hypocone to metastyle. The external cingulum is moderately prominent. The anterior cingulum forms a sinuous

shelf, with the anterior slope of the protoloph well excavated above it. The central area of the crown, between the conules, is deeply basined. Wear facettes have been developed on the inner side of the ectoloph between paracone and metacone, and on the inner side of the parastyle. Dimensions: anteroposterior, 4.5 mm.; transverse, 5.7 mm.

The other new upper tooth, ROM 1686, is heavily worn, which condition, together with its premolar-like structure, suggests that it is a deciduous tooth, presumably DM^4. It is more narrowly rectangular than the tooth described above, with a projection at the parastyle. The paracone and metacone are subequal, moderately worn, and connected by a straight ectoloph. The parastyle is prominent, but there is no distinct metastyle. The protocone and hypocone, and their associated crests and conules, are heavily worn, but appear to have been similar to the corresponding parts of ROM 1687. The posterior projection of the metaconule is quite noticeable. There is, in addition to the anterior and external developments of the cingulum, a vestige of it between protocone and hypocone. Dimensions: anteroposterior, 4.4 mm.; transverse, 5.8 mm.

Remarks. All three of these teeth are small for *Epihippus*, or indeed for most hyracotherines. In the two ROM specimens, the straight ectoloph and the absence of a distinct mesostyle exclude them from the molar series, but even in comparison with the premolars of *Epihippus* these teeth seem aberrant. For this reason their generic reference is left in question.

Family HYRACHYIDAE

Hyrachyus intermedius Osborn, Scott and Speir (1878)? Plate VII, figure 2.

Referred specimen. NMC 8659, left M^3, collected by Wickenden and Russell, 1932.

Remarks. The original comments (Russell and Wickenden, 1933, p. 62) on this specimen still stand. The closest structural resemblance is to an M^3 of *Hyrachyus* sp. from the Sage Creek beds of Montana (Douglass, 1903), but in size the Swift Current Creek specimen is more like the M^3 of *H. intermedius* from the Bridgerian or Middle Eocene.

Family BRONTOTHERIIDAE

Diplacodon sp. Plate VII, figure 3.

Referred specimen. NMC 8660, right P^4, collected by R. T. D. Wickenden, 1931.

Remarks. This well-preserved tooth, the largest specimen in the collection, closely resembles the corresponding teeth in the Late Eocene brontotheres *Diplacodon* and *Eotitanotherium*. There is no basis on which to improve the original assignment to *Diplacodon* sp. (Russell and Wickenden, 1933, p. 62).

Order ARTIODACTYLA

Family DICHOBUNIDAE

Genera and species undetermined. Plate IV, figures 1, 2.

Referred specimens: NMC 8663, incomplete lower molar, collected by R. T. D. Wickenden, 1931; ROM 1691, a right M_1; ROM 1692, a worn left lower molar; ROM 1693, trigonid of a lower right molar; all three ROM specimens collected by L. Sternberg, 1949.

Description. Of the new material, the best specimen is ROM 1691, a slightly damaged but quite unworn right M_1. Absence of roots suggests that it is an unerupted tooth. The talonid is wider than the trigonid, a characteristic of M_1 in many dichobunes. The metaconid and entoconid are high and sharp, conoid but with a continuous crest running through them. The protoconid and hypoconid are almost as high and sharp, but are crescentic, the crests forming together a slightly oblique W. There is a stylar cusp between protoconid and hypoconid. A cingulum is present on front and rear of the crown. Dimensions: anteroposterior, as preserved, 6.2 mm.; transverse, 4.6 mm.

The worn left lower molar (ROM 1692) is apparently similar in structure to the tooth just described. Dimensions: anteroposterior, 6.0 mm.; transverse, 4.5 mm.

The incomplete tooth (ROM 1693) is unusually large for a dichobunid. The two preserved cusps are very high and pointed, especially the metaconid. The protoconid is distinctly crescentic, the metaconid slightly so. The anterior arm of the protoconid crest is broadly curved. The edge of the crest is crenulated. Transverse dimension, 8.1 mm.

Remarks. The incomplete lower molar in the National Museum collection was previously designated cf. *Bunomeryx* sp. (Russell and Wickenden, 1933, p. 63). Like ROM 1691 and 1692, it clearly represents a homacodontine dichobunid. Unfortunately, lower molars are not very diagnostic of the genera in this group. Besides *Bunomeryx* Wortman, the present specimens might represent *Hylomeryx* Peterson, *Pentacemylus* Peterson, or *Mytonomeryx* Gazin. These are all Upper Eocene genera. The fourth tooth (ROM 1693) is of the same structural pattern as the others, but is about twice the size of the corresponding part in any of the genera mentioned. Presumably an undescribed genus of homacodont is represented.

The upper molar (NMC 8662) referred with question (Russell and Wickenden, 1933, p. 63) to the Dichobunidae is illustrated on plate IV, figure 3. The absence of an internal cingulum and the peculiar form of the protocone crest make it unlikely that a dichobunid is represented, but I am unable to offer a more acceptable identification at present.

Family AGRIOCHAERIDAE

Protoreodon parvus Scott and Osborn (1887)? Plate IV, figures 4, 5.

Referred specimens. NMC 8664, left M^2, collected by Wickenden and Russell, 1932; ROM 1702, right M^1?, collected by L. Sternberg, 1949.

Description. The National Museum specimen has been fully described previously. It is re-illustrated in figure 4 of plate IV. The new specimen is very similar, but slightly larger and less worn. It is marginally imperfect in the protocone and metastyle areas. The paracone and metacone are conoid on their inner slope, flattened on the outer, and together form a W-shaped ectoloph. The parastyle is large and the metastyle is very prominent. Protocone and hypocone are V-shaped, the posterior arm of the protocone V abutting obtusely against the anterior arm of the hypocone V. The posterior arm of the hypocone V becomes marginal and extends to the posteroexternal margin of the tooth. The cingulum is nearly continuous around the crown, forming a shelf on the anterior side of the tooth. Dimensions: anteroposterior, 10.6 mm.; transverse (as preserved), 11.7 mm.

Remarks. As redescribed by Gazin (1955, pp. 49–54), *Protoreodon parvus* and *P. pumilis* (Marsh) are distinguished mainly by the smaller size of *P. parvus*. Comparing the dimensions of the two Swift Current Creek upper molars with those given for corresponding teeth by Gazin it appears that the Canadian specimens are intermediate in size between the two species mentioned. For this reason the identification as *P. parvus* is still given with question. The generic identity, and the close relationship of the Swift Current Creek teeth to *P. parvus* and *P. pumilis* are clearly established.

Family HYPERTRAGULIDAE

Leptotragulus proavus Scott and Osborn (1887). Plate V, figures 1–6; plate VII, figures 4, 5.

Referred specimens. NMC 8668, left M^2, collected by Wickenden and Russell, 1932; NMC 8669, incomplete right M^1, same collectors; ROM 1698, right maxillary fragment with M^2 and M^3, collected by L. Sternberg, 1949; ROM 1699, right upper molar, probably M^2, same collector; NMC 8666, right mandibular fragment with M_1 and M_2, R. T. D. Wickenden, 1931; NMC 8667, incomplete lower molar, collected by Wickenden and Russell, 1932; ROM 1689, right mandibular fragment with DM_4 to M_3, collected by L. S. Russell, 1939; ROM 1690, fragmentary left DM_3, same collector: ROM 1700, right lower molar, probably M_2, L. Sternberg, 1949; ROM 1701, incomplete right M_3, same collector.

Description. The new material referred to this species agrees well with that originally described by me (Russell and Wickenden, 1933, p. 64) from the Swift Current Creek beds. Like the earlier finds, the new specimens are consistently a little larger than corresponding specimens from the Uinta basin (Gazin, 1955, p. 83). The two upper molars in the maxillary fragment (ROM 1698) are also proportionately narrower from front to back as compared with topotypes. The ectoloph is more deeply W-shaped, but the structure of protocone and hypocone is very typical. Dimensions: M^2, anteroposterior, 7.9 mm.; transverse, 10.7 mm.; M^3, anteroposterior, 8.6 mm.; transverse, 11.9 mm.

The mandibular fragment (ROM 1689) bears four teeth, the three molars and an anterior tooth, which, from its molariform pattern, is identified as DM_4. This is a long, narrow tooth, tapering from rear to front; it has three pairs of cusps, the inner cusps of each pair being conical, the outer ones V-shaped, with stylar cuspules between each adjacent pair of outer cusps. The M_3 has an unworn hypoconulid spur with a small crescentic cuspule between hypoconulid and entoconid; this cupsule has its concave side facing posteriorly. Dimensions: DM_4, anteroposterior, 9.3 mm.; transverse, 5.2 mm.; M_1, anteroposterior, 8.1 mm.; transverse, 6.0 mm.; M_2, anteroposterior, 8.3 mm.; transverse, 6.9 mm.; M_3, anteroposterior, 13.3 mm.; transverse, 6.6 mm.

Remarks. The somewhat larger size and slight structural differences of the Swift Current Creek specimens as compared with Uinta material of *Leptotragulus proavus* are not considered at present to be sufficient grounds for excluding the Saskatchewan fossils from that species. All of the specimens listed above appear to represent a single species.

Leptotragulus medius Peterson (1919)? Plate VI, figure 2.

Referred specimen. ROM 1697, right upper molar, probably M^2, collected by L. Sternberg, 1949.

Description. This is a relatively narrow molar, with the paracone situated more internally than the metacone, giving the ectoloph an oblique and almost interrupted course. The mesostyle protrudes from the external margin. The protocone bulges lingually, but not excessively so. The internal cingulum is widely interrupted on the inner slope of the protocone. Dimensions: anteroposterior, 5.6 mm.; transverse, 8.5 mm.

Remarks. This tooth is about the size of the M^2 of *L. medius*, from which it differs in being narrower anteroposteriorly and in having an oblique paracone.

Oromeryx? sp. Plate VI, figures 3,4.

Referred specimens. ROM 1694, right upper molar, probably M^1; ROM 1695, similar to preceding but a little broken; ROM 1696, fragment of upper molar; all collected by L. Sternberg, 1949.

Description. The outline of the crown is oblique, with the paracone inset and the protocone bulging. Paracone and metacone are nearly conical; the mesostyle is prominent. Protocone has a short posterior arm, which terminates abruptly against anterior arm of hypocone. The cingulum is well developed but not mammillate. Dimensions (ROM 1694): anteroposterior, 6.0 mm.; transverse, 7.8 mm.

Remarks. These curious teeth resemble upper molars of *Oromeryx* and *Protylops* in the simple form of the outer cusps and the short, abruptly terminated posterior arm of the protocone. They differ in being distinctly narrower anteroposteriorly than transversely, rather than subequal in these dimensions, and in having a smooth, rather than mammillate, internal cingulum.

Correlation

The identifications given above for the Swift Current Creek mammalian fossils may be set forth in a faunal list, as follows:

Protictops? *borealis* Russell
Mytonolagus petersoni Burke
Paramys sp.
Paramys? sp.
Mytonomys robustus (Peterson)?
Mesonychid, undetermined
Hyopsodus fastigatus Russell
Epihippus sp.
Epihippus? sp.
Hyrachyus intermedius Osborn Scott and Speir?
Diplacodon sp.
Dichobunid, undetermined
Protoreodon parvus Scott and Osborn?
Leptotragulus proavus Scott and Osborn
Leptotragulus intermedius Peterson?
Oromeryx? sp.

One or two of these identifications need to be qualified before too much reliance is placed on them for correlation purposes. Thus the occurrence of *Mytonomys robustus* is inferred from an unusually large upper molar, but the upper dentition is not represented in the type material from Utah. On the other hand, some listings are more significant than would appear. The teeth referred to *Epihippus* sp. seem advanced for a hyracothere, and could be post-Uintan. *Hyrachyus intermedius* is a Middle Eocene (Bridgerian) species but teeth similar to that questionably referred here to *H. intermedius* occur in the Upper Eocene of Montana. Of the species definitely recognized, *Mytonolagus petersoni* and *Leptotragulus proavus* are characteristic of the Uintan Eocene. The teeth doubtfully referred to *Protoreodon parvus* represent either that species or *P. pumilis*, both of which occur in the *Uintan*. Generally speaking, the association of selenodont artiodactyls with a species of *Hyopsodus* is very strong evidence of a Late Eocene age. More precisely, the closest resemblances appear to be with the fauna of the Upper Uinta or Myton member. The Swift Current Creek fauna, therefore, is definitely dated as Late Eocene, and provisionally assigned to Late Uintan (Myton) time.

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PLATE I

1 *Protictops*? *borealis*, new species, holotype, right P^4 or M^1, ROM 1676.
2 Cf. *Protictops*? *borealis*, n.sp., right M_1, or M_2, ROM 1685.
3 *Mytonolagus petersoni* Burke, left M^1, NMC 8653.
4 *Paramys* sp., lower right molar, ROM 1677.
5 *Paramys*? sp., right P_4, NMC 8652.
6 *Mytonomys robustus* (Peterson)?, upper right molar, ROM 1678.

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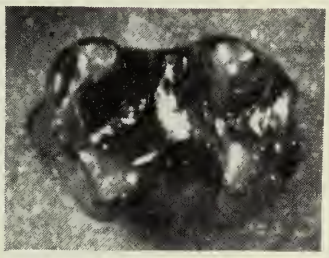

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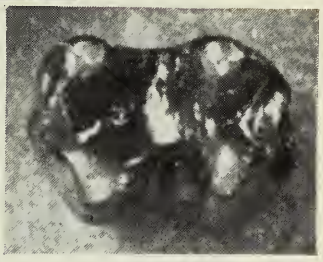

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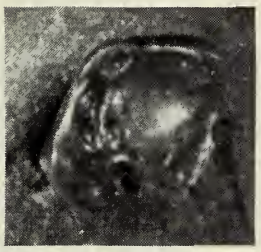

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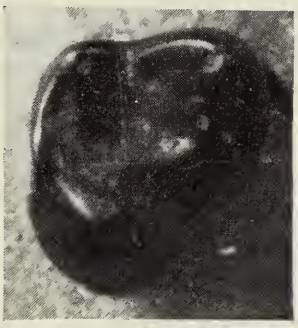

6

×4.5

PLATE II

Hyopsodus fastigatus Russell

1 Holotype, left M_2, NMC 8654.
2 Paratype, lower left molar, NMC 8655.
3 Lower left molar, ROM 1683.
4 Lower right molar, ROM 1682.
5 Right M_3, ROM 1684.

1

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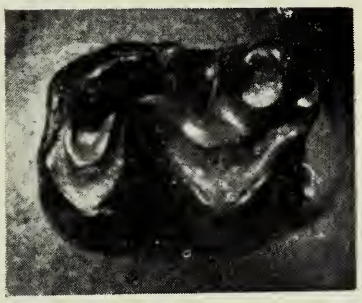

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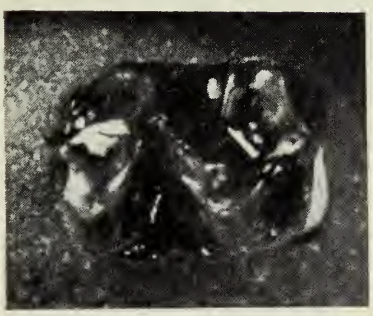

3

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4

×6

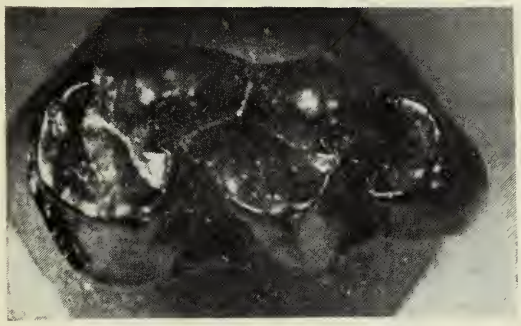
5

×6

PLATE III

1 *Hyopsodus fastigatus* Russell, referred right M^1, ROM 1681.
2 *Epihippus* sp., left M_3, ROM 1688.
3 *Epihippus*? sp., incomplete upper left molar, NMC 8661.
4 *Epihippus*? sp., right P^4, ROM 1687.
5 *Epihippus*? sp., probably left DM^4, ROM 1686.

1
×6



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3

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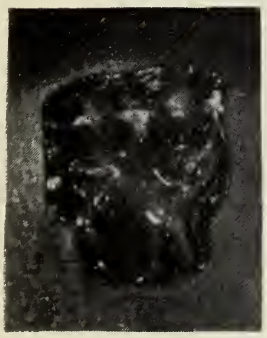

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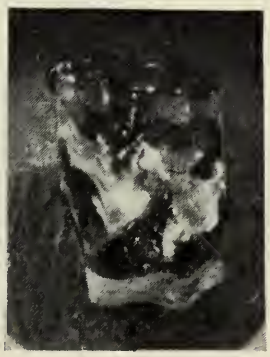

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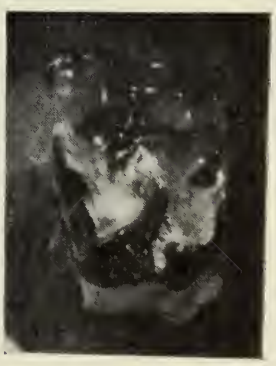

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PLATE IV

1 Dichobunid, trigonid of a lower right molar, ROM 1693.
2 Dichobunid, right M_1, ROM 1691.
3 Dichobunid?, upper left molar, NMC 8662.
4 *Protoreodon parvus* Scott and Osborn?, left M^2, NMC 8664.
5 *Protoreodon parvus* Scott and Osborn?, probably right M^1, ROM 1702.

1

×4

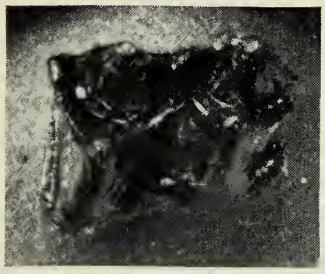

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PLATE V

Leptotragulus proavus Scott and Osborn

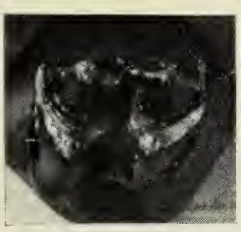
1 Left M^2, NMC 8668.
2 Incomplete right M^1, NMC 8669.
3 Right maxillary fragment with M^2 and M^3, ROM 1698.
4 Probable right M^2, ROM 1699.
5 Probable right M_2, ROM 1700.
6 Incomplete right M_3, ROM 1701.

1 ×2

2 ×2

3 ×2

4 ×2



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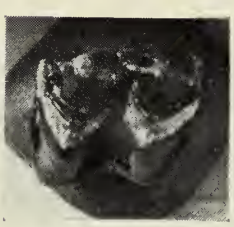
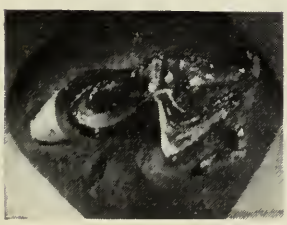




6 ×2

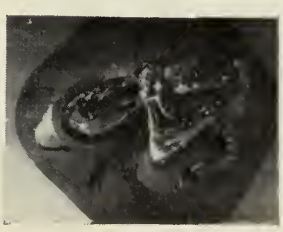
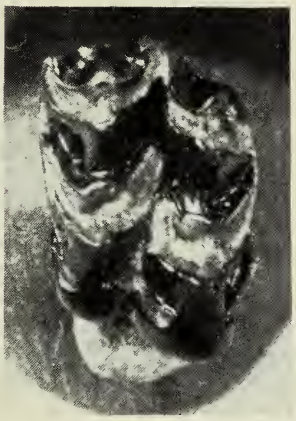


PLATE VI

1 *Mytonolagus petersoni* Burke, left mandibular fragment with P_3 to M_2, ROM 1679.
2 *Leptotragulus medius* Peterson?, probable right M^2, ROM 1697.
3 *Oromeryx*? sp., probable right M^1, ROM 1694.
4 *Oromeryx*? sp., probable right M^1, ROM 1695.

1 ×4



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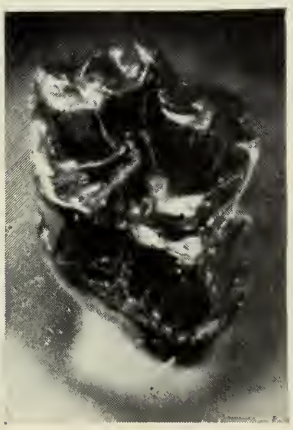

PLATE VII

1 Mesonychid, right P^4, NMC 8651.
2 *Hyrachyus intermedius* Osborn, Scott and Speir?, left M^3, NMC 8659
3 *Diplacodon* sp., right P^4, NMC 8660.
4 *Leptotragulus proavus* Scott and Osborn, right mandibular fragment with DM_4 to M_3, ROM 1689, external view.
5 Same specimen as in figure 4, dorsal view.

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×1.5

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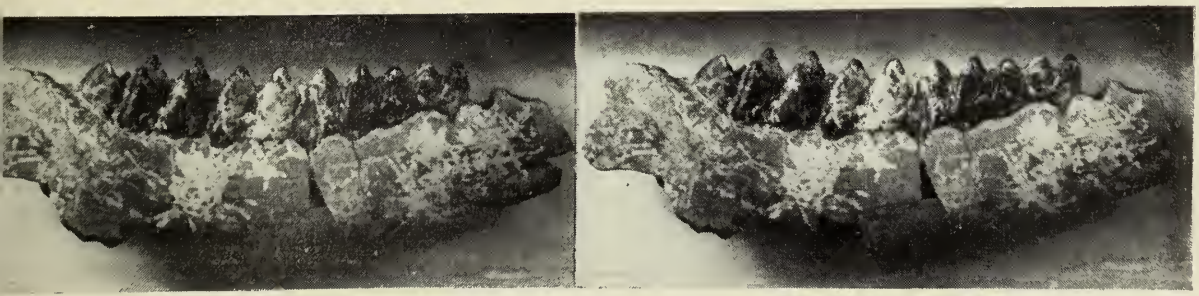
×1



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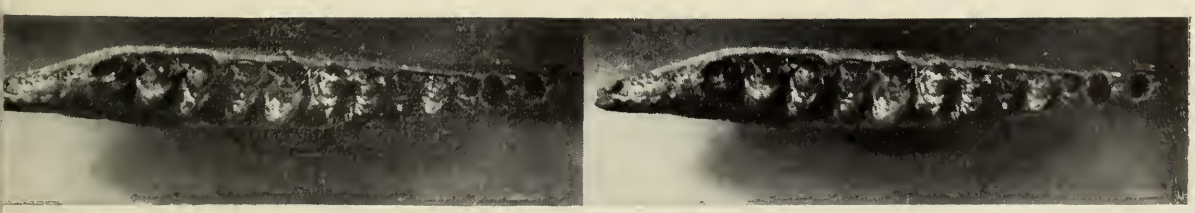

5 ×1